Faculty of Computer Science and Information Technology

A Methodological Modeling of Emotion-Oriented Application in using Agent-Oriented Modeling

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DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

Successful application nowadays requires the software engineer to consider the emotional needs of people. Emotion is intense feeling that are directed at someone, something or not at anything at all. It has been reported that the emotion consideration is needed to capture of what user want to feel and ensure all concern from users are into take consideration. Meanwhile, it has been indicated that capturing users' emotional is needed for the acceptance of interactive application. Furthermore, considering the people feelings and emotions can uptake of interactive system, uncover new requirements and to improved system. Recent studies are not fully cover how to include emotional goal within the software development life cycle. Without proper guidance on how to incorporate user emotional goal within the software development life cycle, software engineers tend to ignore these goals as the project progresses to the next phase. Meanwhile, none of the technique proposed so far enables us to elicit user emotional goals. It is important to incorporate emotion thinking throughout the software development life cycle. In other words, how to elicitate user emotion, design the emotion-oriented application and implement it is yet to be explored. Based on these observations, it is sensible to claim that there was existing gap to fulfilling user emotional requirement throughout software development life cycle. Thus, this research bridge the gap to fulfill user emotional requirement by extending the initial works that claim the AOM can model the emotion-oriented application. This thesis introduces a systematic way to model an emotion-oriented application through Agent oriented Modeling (AOM). AOM is agent-oriented methodology that is compliance with model driven architecture and uses the concept of agent in all stages of its process through modeling steps. In this thesis, the AOM is extended to guide the elicitate, analysis, design and implement of emotion-oriented application, a kind of interactive application. The extended AOM is evaluated in qualitative

and quantitative manner through case studies of Quiz MASter. From the finding of the qualitative analysis, it showcases that extended AOM is useful for designer to systematically model an emotion-oriented application. All of the student believe the capability of AOM to model the emotion-oriented application. Meanwhile, the quantitative analysis can be concluded that the extended AOM is useful for students in producing emotion- oriented application systematically.

Keywords: Methodology, emotion, agent-oriented modeling, eLearning, design

Metodologi Modeling Ekspresi Emosi dengan Menggunakan Pemodelan Berorientasikan Agen

ABSTRAK

Aplikasi yang berjaya pada masa kini memerlukan jurutera perisian untuk mempertimbangkan keperluan emosi seseorang. Emoasi adalah perasaan kuat yang ditujukan kepada sesorang, sesuatu atau tidak kepada mana-mana perkara. Telah dilaporkan bahawa mempertimbangkan emosi adalah perlu untuk menangkap apa yang ingin dirasakan oleh pengguna dan memastikan semua perhatian dari pengguna dipertimbangkan. Sementara itu, telah ditunjukkan bahawa memaparkan emosi pengguna diperlukan untuk penerimaan aplikasi interaktif. Selanjutnya, dengan mempertimbangkan perasaan dan emosi orang dapat menggunakan sistem interaktif, mengetahui keperluan baru dan memperbaiki sistem. Kajian terbaru tidak merangkumi sepenuhnya bagaimana memasukkan matlamat emosi dalam kitaran hidup pengembangan perisian.Tanpa bimbingan yang tepat tentang bagaimana memasukkan matlamat emosi pengguna dalam kitaran hidup pengembangan perisian, jurutera perisian cenderung mengabaikan matlamat ini ketika projek ini berjalan ke fasa seterusnya. Sementara itu, tidak ada teknik yang dicadangkan setakat ini yang membolehkan kita memperoleh tujuan emosi pengguna. Penting untuk memasukkan pemikiran emosi pengguna sepanjang proses pembangunan. Dengan kata lain, bagaimana memaparkan emosi pengguna, merancang aplikasi berorientasikan emosi dan melaksanakannya masih belum diterokai sepenuhnya. Berdasarkan pemerhatian ini, masuk akal untuk mendakwa bahawa ada jurang yang ada untuk memenuhi keperluan emosi pengguna sepanjang kitaran hidup pengembangan perisian. Oleh itu, penyelidikan ini merapatkan jurang untuk memenuhi keperluan emosi pengguna dengan memperluas karya awal yang mendakwa AOM dapat memodelkan aplikasi

berorientasi emosi. Tesis ini memperkenalkan cara sistematik untuk memodelkan aplikasi berorientasi emosi melalui Pemodelan Berorientasikan Ejen (AOM). AOM adalah metodologi berorientasikan ejen yang mematuhi seni bina berdasarkan model dan menggunakan konsep ejen dalam semua peringkat prosesnya melalui langkah-langkah pemodelan. Dalam tesis ini, AOM diperluas untuk memandu penjelasan, analisis, reka bentuk dan pelaksanaan aplikasi berorientasi emosi, semacam aplikasi interaktif. AOM yang diperluas dinilai secara kualitatif dan kuantitatif melalui kajian kes Quiz MASter. Dari penemuan analisis kualitatif, menunjukkan bahawa memperluas AOM berguna bagi pereka untuk memodelkan aplikasi berorientasikan emosi secara sistematik. Semua pelajar mempercayai kemampuan AOM untuk memodelkan aplikasi yang berorientasikan emosi. Sementara itu, analisis kuantitatif dapat disimpulkan bahawa AOM yang diperluas berguna bagi pelajar dalam menghasilkan aplikasi berorientasikan emosi secara sistematik.

Kata kunci: *Metodologi, emosi, pemodelan berorientasikan-agen, e-pembelajaran, reka bentuk*

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LIST OF ABBREVIATIONS

AOM	Agent-Oriented Modeling
AOSE	Agent-Oriented Software Engineering
CIM	Conceptual Domain Modeling Layer
FCSIT	Faculty of Computer Science and Information Technology
HOMER	Human-Oriented Method for Eliciting Requirement
KE	Kansei Engineering
MOOCs	Massive Open Online Courses
PIM	Platform Independent Model
PSM	Platform Specific Design and Implementation Layer
UML	Unified Modeling Language

CHAPTER 1

INTRODUCTION

1.1 Research Background

Emotion-oriented application is an application that considers the emotional or users feeling in application development (Curumsing, 2017). Learning technology like online quiz and Massive Open Online Courses (MOOCs) are examples of emotion- oriented application to prepare a more engaging and interesting learning environment for students (Sim et al., 2019). To date, the development of quiz can derive from simple multiple-choice questions (Zhao, 2019), true or false, drag-and-drop (Gamage et al., 2019), selecting from a dropdown menu (Gamage et al., 2019) to advanced interactive the Quiz MASter (Leung et al., 2013) like emotion-based Quiz MASter (Sim et al., 2019).

Quiz MASter is educational game-based learning that integrated with an intelligent software agent to provide appropriate feedback to the learner (Leung et al., 2013). Meanwhile, emotion-based Quiz MASter is a quiz application involved the virtual character to comfort students through various emotion elements and feedback during the quizzes (Sim et al., 2019).

Massive Open Online Courses (MOOCs) is a new way of delivering interactive learning activities to a large number of learners through online learning platform like Coursera, Udacity, Udemy, edX and Open Learning. In MOOCs, students are able to watch short video lectures, read the digital readings, perform interactive assignments, take the quiz and online discussions anytime and anywhere (de Jong et al., 2019). In this case, student will feel better control in learning (Sim et al., 2019).

From the review, the 21st learning technology involve three design principles. The principles are:

i. Representation

ii. Action and expression

iii. Engagement

The principles of representation (Courtad, 2019) covers teacher's ability to convey the required knowledge to learners by using variety of technologies rather relying on students to read and answer questions on the textbook. For example, the usage of multimedia such as audio and visual allow students to become engaging when mastering new knowledge. Action and expression covers student's ability to express their understanding with the technology dependable. For example, Flipgrid is a video sharing platform allow students to respond to their teacher through video discussions that appear in the website instead of focusing on the written only.

Engagement is the principles to motivate learners by allowing them to choose topic that is workable for them (Courtad, 2019). Khan et al. (2017) comments that the student engagement is a key success of teaching and learning. Without the engagement, it will create obstacle for knowledge absorption and successful in completing lesson in MOOCs or any related application (Deng, Benkendorff & Gannaway, 2019).

The learner engagement is focused on three primary domains: cognitive, behavioral and emotional (Nguyen, Cannata & Miller, 2016). Cognitive engagement is associated by seeking an additional information on the materials, prepare for and complete the quizzes, and desire for learning (Daniels, Adams & McCaffrey, 2016).

Behavioral engagement refers to student's level of contribution exhibited in classroom activities (Nguyen, Cannata & Miller, 2016). For example, student participation or attendance, asking question, follows classroom expectations. Lower behaviour engagement can be displayed when student is being disruptive in the classroom or disobeying an administrator. Emotional engagement is referred to the emotional connection among students with the institutions, instructors, peers and MOOC content (Jimerson et al., 2003). The emotional element consists of both positive and negative feelings and academic communities.

It has been reported that considering user emotion in MOOC learning is important to affect learners' engagement (Chen et al., 2017). When the students are in a positive feeling, they feel motivated to learn and interest to watch the video lectures in MOOC and work on learning activities (Nguyen, Cannata & Miller, 2016). As a result, the students able to complete the learning activities and able to improve their academic achievement. In contrast, when the students have negative feeling like confused and frustrated, they tend to not complete the leaning activities and watch the video in MOOC (Yang, Kraut & Rosé, 2016). Hence, it leads to poor academic achievement.

Work has been done to understand user emotion when learning MOOC (Chen et al., 2017). Chen et al. (2017) investigate the relationships between learner's emotion and different types of MOOC videos by applying Kansei Engineering (KE) methodology.

Kansei Engineering is a methodology that cover emotion, impression, feelings and demands into products parameter to meets consumers' demands (Valentinie, 2016). Three stages were applied (Chen et al., 2017). First, the different types of MOOC videos were selected.

After that, the list of KE words that are related to learning process was adapted in the second stage. Then, the collected words were reduced using the principal component analysis (PCA).

From the study, use *Picture in picture, Text overlay, Khan Style Tablet Capture, Screencast* and *Animation* are among types of MOOC videos that produce positive emotion to the student. Conversely, the negative emotions of the student can be found towards MOOC videos, which are *Talking Head, Udacity style tablet capture, Actual paper or whiteboard* and *Classroom lecture.*

Recent studies are not fully cover how to include emotional goal within the software development life cycle. Without proper guidance on how to incorporate user emotional goal within the software development life cycle, software engineers tend to ignore these goals as the project progresses to the next phase. Meanwhile, none of the technique proposed so far enables us to elicit user emotional goals. It is important to incorporate emotion thinking throughout the development process (Curumsing, 2017).

In other words, how to elicitate user emotion, design the emotion-oriented application and implement it is yet to be explored. Based on these observations, it is sensible to claim that there was existing gap to fulfilling user emotional requirement throughout software development life cycle. Thus, this research bridge the gap to fulfill user emotional requirement by extending the initial works that claim the AOM can model the emotion-oriented application. This thesis introduces a systematic way to model an emotion-oriented application through Agent oriented Modeling (AOM). AOM is agent-oriented methodology that is compliance with model driven architecture and uses the concept of agent in all stages of its process through modeling steps.

This thesis contributes in introducing a systematic way to capture emotion or user feeling and transform into design and implementation through extended Agent oriented Modeling (AOM). With extended AOM, it allows the stakeholder to elicitate, discuss, analyses emotion and guide to design the emotion-oriented application and implementation among the software development team or novice users in a systematic way.

In turn, early requirements can reduce the number of errors by involving the stakeholders for as long as possible. Also, it improves the comprehensiveness of the emotion-oriented application and this indirectly will reduce the cost to redevelop the application as user experience can be improved early (Curumsing, 2017).

1.2 Research Questions

This can be achieved through the following set of research questions:

i. How to elicitate user emotion, design the emotion-oriented application and implement?

ii. How to evaluate the useful of AOM through proposed approach?

1.3 Research Aim

The aim of this research is to introduce Agent oriented Modeling to model, an emotion-oriented application. By having complete set of models for emotion-oriented application, it can serve as a guide to design, redesign, and discuss the emotion elements among the software development team.

This is important for better debugging and project management especially for emotion-oriented application.

1.4 Research Objectives

This can be achieved through the following set of objectives:

i. To extent the AOM with emotion model.

ii. To evaluate the proposed model with novice users through case studies.

1.5 Research Scope

This research focuses on interactive application development through emotion capturing, analysis and design using the Agent oriented Modeling (AOM).

AOM covers Emotion-oriented goal model, Emotion-oriented role model, Emotion-oriented organization model, Emotion-oriented Tropos goal model, Emotion-oriented domain model, scenario model, interaction model, behavior model and development model. Meanwhile, the research is not for automated emotion capturing or tools for emotion modeling.

1.6 Thesis Structure

This thesis consists of seven chapters. The synopsis of each chapter is described in the following:

Chapter 1 presents the overall introduction to the topic, including the research background, research objectives, research aim, research outcome and the thesis structure.

Chapter 2 presents the literature review that describes the background study on AOM background. In addition, this chapter describes the engagement design principal in learning technology. This follow with the previous work of emotional goal. Finally, this chapter conclude the Agent oriented Modeling (AOM) as proposed solution.